Modeling Broadcasting Infrastructure

By Daniel K. Flatla

Editorial Abstract: Mr. Flatla describes the creation of a prototype geographic information system which models the television and radio broadcast system infrastructure and broadcast areas of Open Source Center sources. The project reviews the social and interactive processes of media to learn about the spatial relationships between objects such as stations, towers, transmitters, and owners within the broadcasting system.

Compared to Al Qaeda, the United States has been successful in its military operations in Iraq, Afghanistan, and Somalia. The US projects power and money to rebuild these nations, but lacks engagement on what World War II era analysts called "The Fourth Front" (Graves, 1941), or what President Eisenhower called the "struggle for the minds and wills of men." (Bowie & Immerman, 1998) Both intelligence and the news reporting describe the impact of Al Qaeda's As Sahab Media Center within Muslim countries, and their ability to recruit new supporters. At the same time the US is having difficulty beginning a successful strategic communication strategy to counter As Sahab's influence. It is the fourth front that encompasses social processes of media and information which influence understanding, feelings, and values. Understanding the effects of media on various cultures—as social and spatial processes—is critical for the United States to understand and to engage this fourth front.

1.0 The Problem

"I believe the geospatial framework is essential to understanding and acting upon media ecology from an intelligence perspective. Finding Usama [bin Laden] may well be important but the key to the problem is really understanding how the message is delivered and how and why it affects populations, small and large, and where these populations are located. In order to drain the swamp you not only have to know where the swamp is but what are the sources of its swampiness." (Senior OSC Editor, Oct 2007)

Understanding social and cultural change is a challenging task for all aspects of government, and the Open Source Center (OSC) is no different. The mission of the Open Source Center is to monitor and analyze publicly available information. They specifically analyze international media such as print, broadcast, geographic information, and other forms of public communication. The OSC provides support to senior policy makers and the US Intelligence Community regarding current events as well as providing detailed research. As the client in this project, they requested

Transmitter tower, Kirkuk, Iraq. (Defense Link)

a prototype enterprise geospatial information systems (GIS) design to specifically to enable OSC staff to model the infrastructure and phenomena of television and radio broadcast systems. OSC partners want to understand the effects of media.

For instance, an open source analyst is researching a businessman turned politician in Iraq. The analyst finds information about the politician and his family, who are known to own a television station and a radio station in a city in Kurdistan. The analyst wants to know the impact of the man's media ownership on the surrounding population. Did it affect voting habits, purchasing habits, women's rights, or civil order in the politician's media sphere? Currently, OSC can manually place the pieces of this puzzle together in the form of textual reports, stringing together hundreds of information sources. This results in analysts printing out and stacking reports on their desks, forcing them to perform a paper management exercise to link content, in order to identify key concepts and relationships in their research.

The problem for those studying media environments anywhere is a matter of storage, retrieval, and updating of local events and sources of information—*not* a matter of content. Analysts require a means to locate and discover spatial and social relationships. A typical consumer of open source intelligence can spend four to six hours per day culling through overwhelming volumes of information, consisting of news, rumors, and other reports. Users have the challenge of connecting their sources, influencers, and events of the day, to maintain situational awareness to support their superior's decision making process. The US Government applied network storage to information acquisition problems years ago, with systems designed to manage text documents. Today the problem is a matter of discovering the "so what" users are trying to get from government information systems. With even larger databases of event reporting in "cultural spaces" coming online, and a larger push to collect "human terrain" data, information overload may cause our analysis to grind to a snail's pace. Time and resources required to meet this future outlook don't make a typical user's job any easier.

This project focused on developing a prototype GIS architecture around

ESRI's [originally Environmental Systems Research Institute, Inc.] geodatabase technology. The project explored methodologies which support media researchers and analysts in understanding international media and culture, through creation of a geodatabase to model television and radio infrastructure. The project took into account various organizations' media monitoring activities and data to model media sources in Iraq, to deliver a prototype geodatabase for global access to the OSC and its partners. Tools such as the Department of Commerce's Communication Systems Planning Tool (CSPT) were used to model the electromagnetic propagation of transmissions areas of these systems to support visualization and analysis.

The project architecture supports an enterprise-wide need by focusing on common features and attributes that describe the terrestrial television and radio environment. It creates a number of basic analytic models and tools to calculate values of media penetration within a country or market. Although the analytic output is quantitative and describes the patterns of media and cultures, it is by no means indicative of the processes of media and society that are occurring in the study areas. The project's basic analytic components assist with the discovery of spatial patterns that can help inform researchers dealing with advanced, complex social, cultural, and psychological processes that factor into studying media environments.

The project studied the spatial characteristics and the relationships of media infrastructure to create a data model the utilizing ESRI *ArcSDE* geodatabase technology. The model focused on storing the location of radio and television stations, along with their related transmitters and towers, plus tables of transmitters, owners, managers, and alternative names. The primary reason for using *ArcSDE* was to emphasize the interconnectedness of the infrastructure, through relationships connecting features and tables to one another. ArcGIS technology allows for specific behavior such as relationships to be stored in the geodatabase. The infrastructure behaves in way best suited for an object-relational database management system such as ArcSDE and Microsoft SQL Server. Also, such technologies show how common commercial hardware and software can be applied to any final solutions derived from this study.

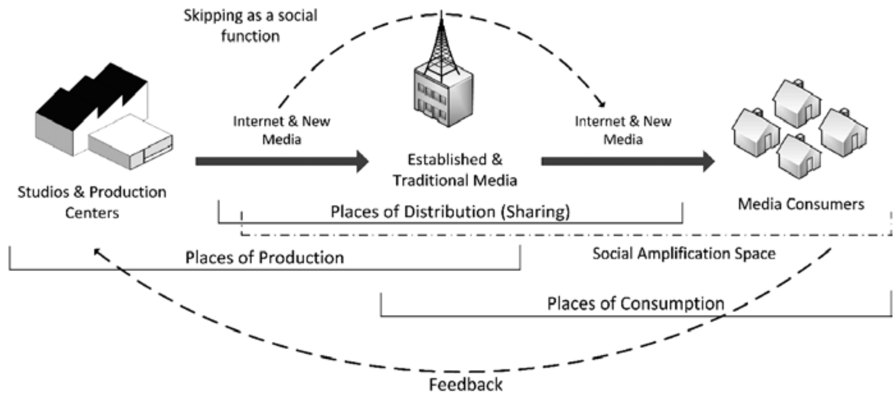

Figure 1. Geography of media. The social aspects of media, production, distribution, and consumption, occur in space. (Author)

2.0 Geography of Media

"All media work us over completely. They are so pervasive in their personal, political, economic, aesthetic, psychological, moral, ethical, and social consequences that they leave no part of us untouched, unaffected—unaltered. The medium is the 'massage.' Any understanding of social and cultural change is impossible without knowledge of the way media works as environment." (McLuhan, Fiore, & Agel, 2001, p. 26)

The overall OSC effort attempts to re-establish abilities that originated with the Princeton Learning Center (PLC) and The Radio Project of the 1930s-40s: studying international media as a whole, especially focusing on places of production, distribution, and consumption. While the geography of media spaces has not been well researched (Couldry, 2001; Strate, 1999), previous media studies encompassed multiple disciplines—like sociology, psychology, and anthropology—to engage the subject in a critical, audience-focused manner. Yet within academia, these multiple disciplines remain segregated, with only a handful of researchers having managed to approach their studies with cross-disciplinary theories (Couldry & McCarthy, 2004; Livingstone). Only recently have media researchers considered the *places*, and began to include spatial considerations they may have previously overlooked.

Couldry & McCarthy describe five levels in their introduction to Mediaspace: the representation of media space; the flow of data and how media space is reconfigured; the specific places at the ends of spectrum of media space (production and consumption spaces); the effects and complexity of geographic scale; and finally how media is understood at various scales (Figure 1). Understanding the geography of media contributes to representing media at different scales, applying a level of complexity not normally addressed in most listenership or audience studies. The relationships between source and receiver contribute to the flow of information, and directly to their spatial effects.

Many studies note *Tobler's First Law of Geography* (TFL): "Everything is related to everything else, but near things are more related than distant things." (Tobler, 1970, p. 236) This could certainly apply to media research. Researchers often describe social processes spatially, without knowing the effects of geography on media. For example, there is the separation between producer and consumer, where production places like studios are separate from the consumer's locale. Workplaces or personal service providers like barber shops are other examples of where the

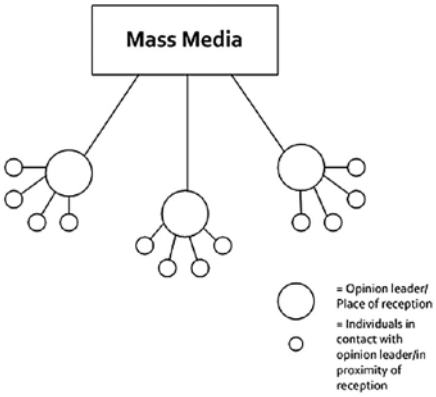

Figure 2. Lazarsfeld's Two Step Flow theory. (Author)

media evokes the spatial aspect of the social process (Ossman, 2004). In these places, personal, cultural, and historical factors apply to discussions about consumed media, which either amplify or dampen the effect at the local level of social space. This effect was modeled by Lazarsfeld (1944) with a Two Step Flow theory (Figure 2), where the mass media is first received by opinion leaders, and secondly individuals in proximal social contact are influenced by the opinion leader. The social factors of influence then act according to geographic, social, cultural, and historical factors within the group of individuals. The Two Step Flow Model focuses on social aspects, but is dependent upon proximity to media and interpersonal relationships rather than accepting previous assumptions that media had a direct effect on those it touched (Katz & Lazarsfeld, 1955). Applying TFL to the model, influence decays over distance—social, geographic, or temporal.

Several models referenced in communication studies (Gerbner, 1956; Maletzke, 1963; Schramm, 1954) imply that geographic processes occur in communications. One is Berlo's S-M-C-R Model (Berlo, 1960). It categorized elements of a medium such as the source (S), message (M), channel (C), and receiver (R) in a linear fashion and focus on the interpersonal relationship of communication. The Osgood & Schramm Model (1954) is a modified circular model, it captures the cyclic nature of communication where there is a processing role within each receiver/transmitter and the application of feedback at multiple stages. Schramm (1954) also created a Field of Experience model (Figure 3), positing that the overlap of an individual's experience with others contributes to the understanding between groups of people. This overlap makes it easier to communicate successfully with others, emphasizing a connection through likeness. Schramm's experience model exhibits elements of TFL, where again receivers closer in proximity are more related than receivers further away—or with less similarity in social space. Application of the Field of Experience Model may further describe the social processes occurring at the second influence step in Lazarsfeld's model, where experience and proximity affect media's amplified social process.

Influence or ideologies are often primarily associated with the study of the media, limiting the approach to studying what people do with the medium and the message. Individual perception of media and identity is an overlooked factor in media research, and considered a possible area of further research (Corner, Schlesinger, & Silverstone, 1998). These processes of media creation, sharing, and consumption are self-selecting because of identity and geography. An individual determines what media, and with whom, they are going to produce, share, or consume, based on their experience and place in the world. Use of behavior as an approach to media study implies application of sociological, anthropological, and socio-psychological theories to explain an individual or group's rationale for producing, sharing, or consuming media. Nonetheless, many media researchers accept external factors may be at work—whether ideological, behavioral, or something completely different—adding to media's complex effects (Corner et al., 1998; Couldry, 2001; Katz, 1959; Livingstone, 1997; McLuhan, 1964). Using GIS to map patterns and processes could help to further the study of media effects as the social processes occur spatially, but may not ever be the definitive answer to fully understanding media effects.

2.1 Mapping the Media

The study which closely compares to this project was conducted by a team of researchers from the University of Calgary, The Carter Center, and the Canadian Foundation for the Americas (FOCAL) (Cole, 2005; Dowding, Hansen, Sun, ReMartinez, & Waters, 2006; McConnell, Hansen, & Waters, 2005; Waters, Hansen, Gao, Sun, & Palacios, 2006). In 2003, The Mapping the Media in the Americas (MMA) project began mapping access and ownership in the Americas. Their intent was to provide insight for change into political campaign financing and political use of media.

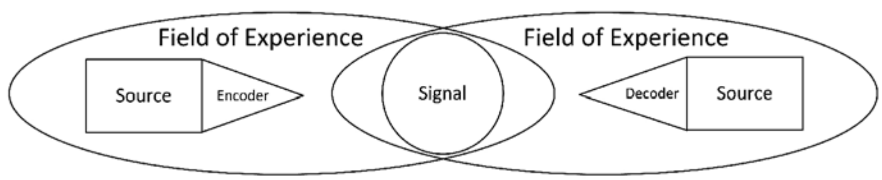

Figure 3. Schramm's "Field of Experience" Model (1954).

The MMA utilized partnerships with non-governmental agencies and the media within its study areas to collect international data, build a GIS, and to provide an Internet mapping site. The Carter Center and FOCAL conducted the data collection abroad, meeting with media sources, government agencies, and journalists to collect media ownership data. This consisted not only of who owned radio stations, but the locations of who owned a radio. The University of Calgary, built and utilized the GIS, processed and analyzed the data, and generated maps. They also designed an Internet mapping site for the MMA project, ultimately meeting the project's intent of providing greater transparency into political financing of media during elections.

The MMA's methods and analyses consisted of locating media sources and potential receivers, and comparing them to election outcomes. They modeled the range of station broadcast signals to determine potential listenership in an area, then performed geographically weighted regression (Fotheringham, Brunsdon, & Charlton, 2002) on election results. This allowed MMA to account for regional differences, and determine where political parties did well (or not). Geographically weighted regression also let them estimate numbers of radio owners throughout the country, which the researchers determined as successful in predicting election outcomes (Dowding et al., 2006).

2.2 Partnership and a Beginning

In 2006, OSC media analysts and geographers started their media mapping effort. The geographers acted on suggestions from a branch chief's 2006 internal email, recommending the two groups "do something together." The geographers wrote a proposal to locate OSC media sources, and with help from media analysts, picked Iraq as prototype area. The OSC used their sources and those of the BBC Monitoring Service, to include the *World Radio and Television Handbook,* to populate a table of attributes about the available sources in Iraq. This initial product consisted of over 30 attributes and over 400 stations—many duplicates—and the aggregated data were difficult to pull together, due to the varying methods the sources used to describe the information. There were no coordinates for the locations of broadcast towers, only addresses for studios and the name of the location where the broadcast tower 'might be.' A join between the location attribute of the transmission sources table and a populated places GIS file provided the probable point location for the transmitter data.

While creating the Iraq data, the OSC team placed station locations as accurately as they could. This process introduced errors into the data because locations were not in the exact locations of the real stations. When users zoomed into the data, the depiction began displaying errors, due to the production method of placing features by hand. For instance, if one zoomed into Baghdad, transmitters created for the project would appear randomly distributed through the city—but they are not. The original data creation process introduced spatial errors that, at large scales, display significant inaccuracies which analysts could misconstrued as accurate (Figure 4). Nevertheless, the fact that OSC could plot source locations in a GIS was a tremendous step toward integrating different OSC aspects, and helped reinvigorate collection and analysis processes. By working together, the two OSC groups demonstrated that media analysis has a geographic component, and that OSC's corps of geographers could do more for the Center than just manage a map library.

Figure 4. Uncertainty of transmitter placement. Note the stations placed in the river. (Author)

During this first phase, OSC geographers also thought to map broadcast areas of Iraq sources with signal transmission information. At the time, OSC did not have the tools to model radio frequency propagation; 1941 appeared to be the last time OSC mapped any extent or direction of media. Using OSC's geography blog, "Why Geography Matters," the geographers posted a question to the greater Intelligence Community asking what tools were available to model radio frequency propagation in a GIS. The US Army and the National Security Agency (NSA), responded regarding a tool called the Communication Systems Planning Tool (CSPT), developed by the Institute for Telecommunication Sciences within the Department of Commerce's National Telecommunications and Information Administration. OSC partnered with both groups and forwarded the Iraqi media sources shapefile to be modeled (Flatla & Blinde, 2007).

Because the transmitter shapefile had incomplete technical data about transmitter attributes, the NSA and the Army both used default parameters for the CSPT tool. They generated the 180 broadcast ranges in ESRI GRID raster format, which OSC included in the project. The default values created broadcast ranges approximately the size of a large metropolitan area at a scale of 1:2,000,000—a typical ratio for the type of stations OSC is attempting to model (Figure 5). These default values, mixed with real values, are approximations; they had to be declared as such. For the size of the area involved, any analysis would include metropolitan-sized study areas or smaller scale areas. Similar analysis conducted over Western areas, like the United States or Western Europe, could be conducted at larger scales, but in the case of Iraq the error at larger scales skewed local analysis because of the coarseness and lack of data. Hence, a country-wide range display overlaid on tribal, ethnicity, and population density data demonstrated detailed distribution views in OSC interest areas.

Following the demo, senior OSC managers asked how to integrate the project into OSC's daily workflow, and how it would help OSC. Managers are wary of additional strains placed on their analysts to use new software and new tools. For one, analysts already conducted qualitative source assessments by producing media guides. The earlier media mapping project offered a different approach to creating media guides, and helped diversify the types of analysis OSC conducts. Understanding the extent and reach of media in their locales extends analysts' understanding of the source and media. Visualizing the media and its effects extends analyzing content for nuanced statements directed towards groups or individuals that act in a local capacity. This added context develops an analyst's knowledge of an area's culture and geography, and aids in determining the changes occurring in a given location. Both aspects multiply the organization's knowledge and understanding of media and societies, which contributes to the overall purpose of intelligence and geography—to understand people.

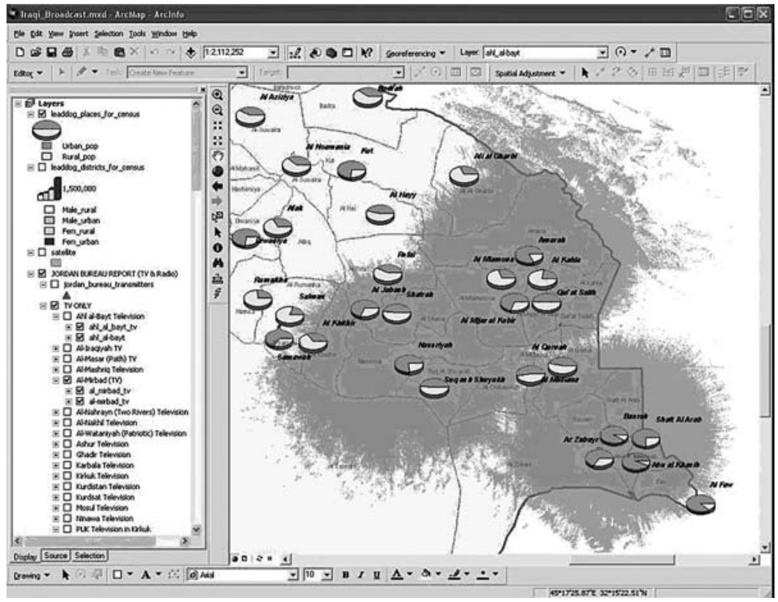

Figure 5. Generated broadcast ranges for OSC by NSA. (OSC)

2.3 Socializing the Project

Previous work attempted to interface with potential partners by using various ways to describe and showcase the project. From a GIS perspective, an ArcIMS site was a Web map of media in Iraq. The mapping Website on the Intelligence Community's unclassified network, Intelink-U, proved to be of little use to partners who work on distributed secure networks. The Website did not offer much interaction with the data, but helped to distribute data to some ArcGIS Desktop users for viewing. The Web mapping site did garner support from OSC's overseas bureaus which collect media information.

Another project website was created on Intellipedia, the Intelligence Community's enterprise wiki, to share methods and data. The Intellipedia portal and pages are some of the IC's most popular, but this platform only offers current information about the project: shapefiles and KML file for Google Earth; tables and images have been uploaded for users to download and use. The wiki pages are an important part of the project for communicating results, and have been a primary information sharing forum.

Blogging added another increased level of transparency to the project. The GIS blog has an important relationship with the Army Information Operations and public diplomacy communities, who actively read and participate. Project direction, methods, theory, and results are posted; as are related datasets, information about new media sources, and related technologies. This active participation has helped to coordinate user needs, and to legitimize the need of the project.

The blog has been one of the more popular elements of the project, offering users and project team members a dialog with partners throughout the Intelligence Community. Yet, one finds that most partners are only interested in obtaining data and not sharing data—yet they love to access the Intellipedia page and blog on the secure networks. All of these interfaces are good for establishing presence, but the project still lacks persistence within the OSC and Intelligence Community enterprise.

2.4 Goals and Objectives

This project created a prototype GIS focused on a geodatabase, to model the infrastructure of television and radio broadcasting systems to support US Government media analysis, public diplomacy, and civil affairs efforts. This prototyping effort also focused on expanding OSC business and research areas to integrate different disciplines geographically disbursed into a framework workflow process. These new workflow processes are intended to leverage the various skills of OSC and its partners, to contribute to an overall effort to locate and analyze television and radio media.

Project objectives also focused on using and expanding a multi-discipline approach to studying media and its infrastructure. The project combined methodology from media and cultural studies, anthropology, sociology, communications studies, and geography the use of GIS to model the infrastructure and phenomena of television and radio. By using a multi-discipline approach, analysts can study phenomena as complex as television and radio media to a much better degree.

Finally, this prototype is intended as a catalyst to improve analysis, geographic literacy, and media literacy in the US Intelligence Community.

Figure 6. The system will use a mapping program to access map data, to create a map (Author)

According to Larry Strate, President of the Media Ecology Association, the geography of media has not been well studied (personal communication, October 6, 2007). Nick Couldry at the London School of Economics (2001), and Lisa Parks in the Film and Media Studies department at the University of California at Santa Barbara (personal communication, May 14, 2008) also note a lack of knowledge in this area. Parks has a book forthcoming on this subject, but notes she is lacking a methodology and resources to map media infrastructure in order to complete her work.

Notably, the same collaborative processes that enable worldwide user participation in a critical USG mission may also support academic research on the subject.

2.5 Project Scope

The scope of the project focused on development of a prototype GIS architecture, including a basic analytic component, to provide users the ability to search for features geographically or by their attributes. The project limited itself to implementing desktop GIS and Web-based mapping tools to perform the basic analysis and query functions, as well as the editing of features in the geodatabase. Access to its geodatabase via Open Geospatial Consortium Web service standards supported inter-agency collaboration.

The project's intended timeframe was within the nine month academic year, it takes to complete the Master of Science in GIS program at the University of Redlands [California]. Project resources were also constrained to hardware and software provided by the University of Redlands, the client, and ESRI. The study area was limited to the television and radio media infrastructure within the country of Iraq, due to its availability from OSC's previous work.

Limitations did not allow for content analysis, nor the typical analysis of media content conducted by OSC and its partners. The project scope was constrained to modeling the media infrastructure of Iraq, with data provided by the client, and not to discover or collect any data. The basic overlay analysis included limited information from country-level population density, tribal and ethnographic data sources. While the project could have included more complex analysis, additional resources would have been required to collect more precise geodemographic data.

3.0 System Description

To meet the needs of OSC and its partners, the project prototype design focused on providing users with the capabilities to contribute and manage spatial, technical, and organizational data about the infrastructure of radio and television sources they monitored around the world. The system was designed to perform queries of the data, to enable users to work collaboratively, the goal being the creation of radio frequency propagation models to support the analysis of media environments and populations. The same data was also intended to be available to advanced users and other enterprise tools via Web services. For users who were less familiar with desktop GIS, the system was designed to include database editing via Web mapping applications. These decisions were based on the roles of open source analysts, public affairs officers, and others who could potentially contribute to the project's geodatabase. The system included commercial off-the-shelf technology and third-party GIS applications in the prototype architecture, giving all users the ability to create maps and communicate via formats like KML for Google Earth (Figure 6).

3.1 Requirements Analysis

The project team interviewed the client and their partner organizations to understand workflows and processes needed to map media sources. Their answers, along with doctrine and processes from the client's partners, formed the basis for prototype system requirements. Derived needs were broken down into two categories: functional and nonfunctional requirements. The functional requirements outlined the capabilities the project prototype

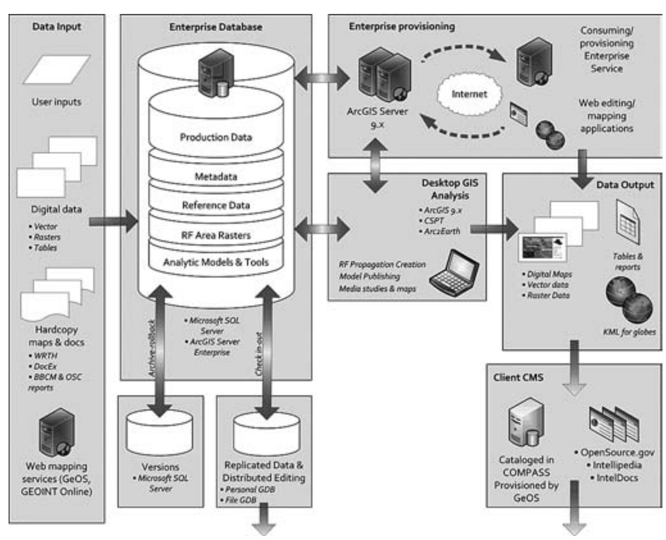

Figure 7. Project architecture. (Author)

needed to address in the project's design and implementation. Nonfunctional requirements did not necessarily support functionality, but addressed aesthetic and specific needs like scalability and software types.

The client's geographers and open source officers responded to interview questions via e-mail. They often explained their jobs and roles, but also provided questions they and their partners often asked during their source analyses activities. Such questions ranged from basic look-up tasks, to questions about spatial analysis, as well as nonspatial questions. Many asked about basic queries, often about where a station was located. More complex spatial analysis questions addressed the broadcast areas and the underlying demographics of the affected population. For example, one analyst asked "What is the geodemographic makeup of listeners within the broadcast range of a specific radio station?" Other client questions included nonspatial questions about station features, such as the language in which it broadcast or who owned or operated the media outlet.

Similar questions or requests for data were described as information needs in the doctrine and field manuals of the client's partners; these needs drove the client's collection and analysis of its sources. The US State Department's model for implementing public diplomacy campaigns includes multiple needs to identify media sources and their potential audiences and to measure the effects of their outreach (GAO, 2006). From a military standpoint, the US Army addressed specific data needs for conducting missions including combat, information operations, public affairs, intelligence, counterinsurgency, and reconstruction operations. The military doctrine cites similar needs to collect, manage, and disseminate information about media infrastructure, information about programming and ownership of the media, and the makeup of the affected population of those media (Army, 2006a, 2006b, 2008; DOD, 2006). Further, documents and manuals from both the State Department and the DOD referenced the need to use knowledge management systems to address their needs, as well as the client's, to support their many Interagency partners.

3.2 System Design & Architecture

As the heart of the system, the geodatabase modeled the concepts of television and radio infrastructure (Figure 7). The logical design utilized information about media infrastructure and previous work done by OSC, leading to a data model that captured the behavior and relationships within the system. The design of the geodatabase essentially brought the prototype system to life. The physical geodatabase powered the rest of the project with its hardware, software, data, and network connections. The remaining elements of the system revolved around the geodatabase, where other applications, user roles and workflows were based on what analysts could do with it.

The intricacies of broadcast infrastructure. (Defense Link)

4.0 Project Operations

The client collected data for review, deconstruction, reassembly, which was then used to fill the prototype. The project demonstrated migration from shapefiles to geodatabases, and the geographic relationships were reviewed and modeled within the geodatabase. The division of features and attributes into separate feature classes, with the addition of relationship classes, introduced the natural relationships between the objects connected as part of television and radio broadcasting infrastructure. The data model and the geodatabase provided a place for the client to start exploring how it can model other media infrastructure, such as satellite and cable television. The geodatabase and data model can now be referenced to expand the client's ability to understand its media sources and the populations it monitors.

Creativity and necessity helped create the prototype applications that enable the client to interact with the data and the platform. These objects combined to construct a proof of concept, such that the client may consider future implementation of these technologies and processes. The geodatabase and platform attempted to demonstrate the collaborative nature of GIS as well. The project implemented technology with as many capabilities to access and share data with the client and its partners as it could. Web Mapping Service, KML service, and the proprietary ESRI service contributed to the dissemination of information and the inclusion of users who work with desktop and Web-based applications. The technology provides room for the creative nature of intelligence analysts to mix and match data from different sources, applying a wealth of different tools—and as many methods to discover information as the user can discover. The proof of concept shows one could learn media infrastructure and geographic relationships, not only for television and radio media, but also for the sociocultural behavior and technology that make up a communication system. These concepts can be applied to satellite, wireless systems, and the Internet—with a little further research. The objects in a given communications system can be modeled in a GIS, and updated with enough frequency to keep up with data support analysis needs.

The system's design and architecture bore a resemblance to other GIS systems that implement similar technology. The System Design Strategies (Peters, 2007) research provided a number of recommendations and introduced the project to multiple GIS implementation strategies. The project applied these very concepts to meet the client's GIS needs for data from multiple sources, and collaborative access. The decision to implement the ArcGIS suite, and provide data services for users of different GIS platforms like Quantum GIS or Google Earth, proved a great example to the client of how OSC could support a large number of users and partners worldwide with geospatial data and analysis.

All users with access to the geodatabase and its services can read the data and conduct their own analysis, or create their own maps for their individual needs. There is certainly the potential for more complex applications utilizing the project's data and services, but this discussion is beyond the scope of this project. A comprehensive work breakdown structure would have extended the length of the project and would have been unnecessary for its size and scope.

5.0 Summary

This effort resulted in the design of a system architecture that included workflows around a geodatabase to store a media infrastructure model and associated data. The project design was prototyped using university and client resources such as servers, software, and data. ArcGIS desktop users could access a geodatabase using a direct connection protocol or an Internet protocol feature. The knowledge take-away from the project is that media—television, radio, satellite, and other forms of communication—can be modeled in an enterprise GIS to support a wide variety of users within the client's organization and its partners. The objects and the relationships that make up a system of media are apparent in the real world, and the relationships, although complex, can be identified and modeled. Further research into a medium of interest is needed, to establish objects, actors, and relationships, as well as social relationships and factors which act on the landscape.

Prototyping the beginning of a new age of media analysis can motivate OSC to implement follow-on and complementary projects, to transform itself and the open source intelligence community, providing deeper analysis to their partners while continuing to provide traditional services. The potential growth fulfills the task set by the Director of National Intelligence and the United States Congress.

Other potential users of the analysis and data include US embassies, military organizations, and OSC's international partners like the BBC Monitoring Service. The global distribution of these users maximizes the need to understand local media. By leveraging this network, users can be significant to a project like this, providing near-real time changes to a global project with access to local media sources. Knowing the geographic extent of media can help relate information and knowledge through various geographic search techniques, and even spatial analysis of data that was once thought to be non-spatial. This vision is achievable, but OSC has to start somewhere—and mapping their media sources is the way.

Finally, a note for the client and those in government who wish to implement GIS platforms for the enterprise: The technology is available, *but the culture is not*. Projects such as this prototype do not power themselves with electricity, servers, and software alone. Users are the driving force behind this prototype and all other systems, especially when communication between users is required in processes that collect, analyze, and share intelligence. An understanding of how the relations work in a system are what makes geography and GIS an important part of OSC's, and the Intelligence Community's, toolbox, which can make an impact on the fourth front.